Jožef Stefan Institute, Ljubljana, Slovenia

RD50 project
3D detectors optimized for timing applications

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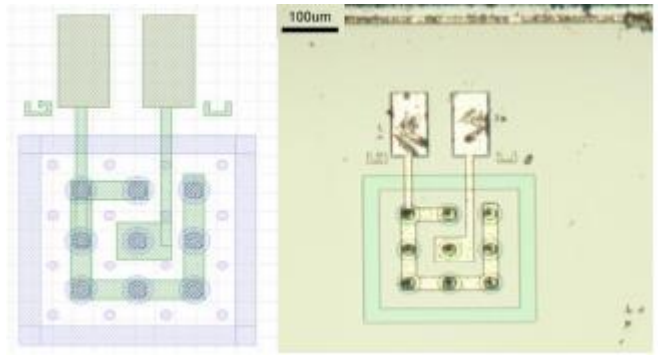
Introduction

Aim of the project is to explore the 3D for timing applications

- similar, but far more ambitious, project financed by INFN
- our goal is to study present technology (3D columns) with different geometries and optimized for present readout options
- Using 3D sensors is a way to mitigate two main obstacles of present day LGADs: radiation hardness and fill factor:
  - Landau fluctuations-> E*Ew field fluctuations
  - Gain in LGAD -> thickness of 3D (effective gain = ratio of thicknesses)



First results look promising:

- With simple structures 50x50 um from CNM we can achieve similar timing resolution as with LGADs (UZH results show, as expected, no influence of irradiation at ~1e15 cm-2 level)

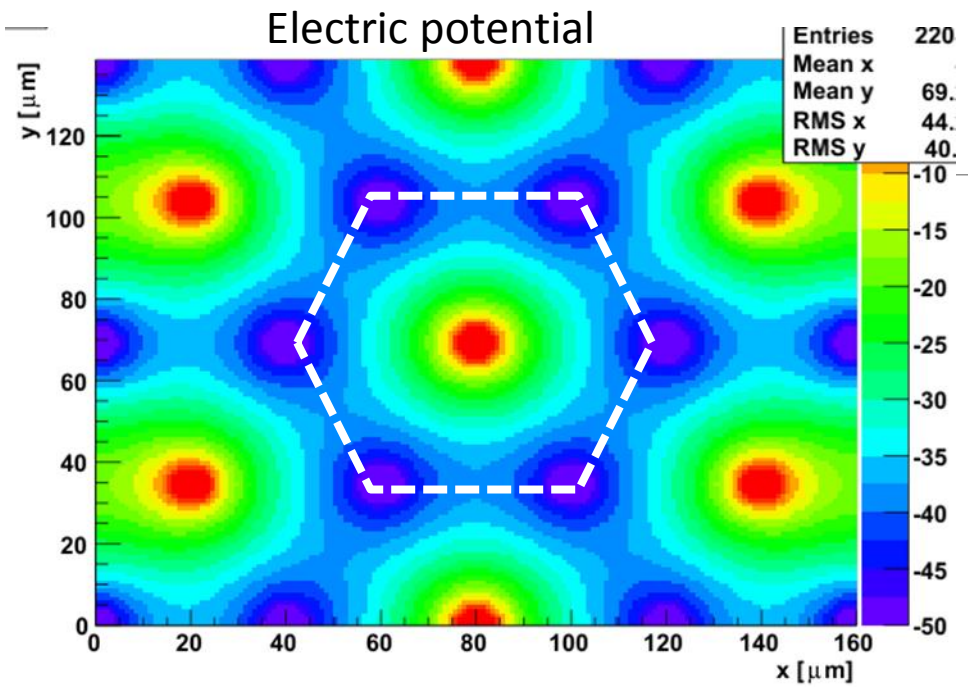
Project plan

- Design and simulations guiding the design (M1-M4)
- Production of the sensors/wafers (8 wafers, 285 μm thick) (M4-M10)
- Production of 4 channel timing measurement boards (M1-M4)
- Testing and signal simulations of un-irradiated sensors (M10-M14)
- Neutron irradiations in large fluence range (M10-M14)
- Testing with different readout electronics and signal simulations of irradiated sensors (M12-M24 months)

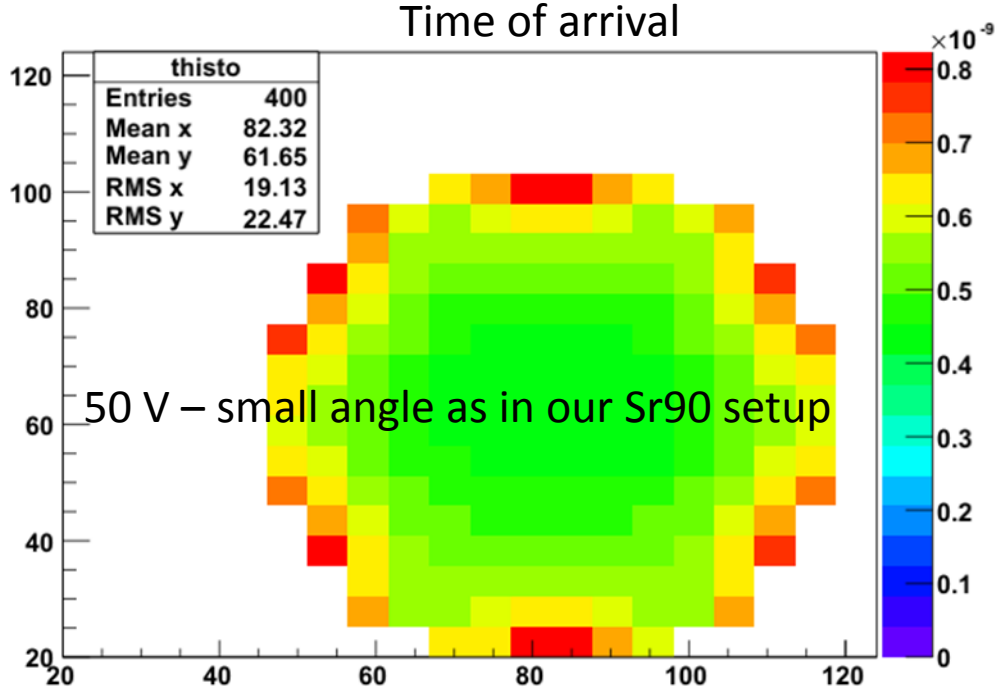
The plan is clearly driven by design and production of the sensors – Covid19 has a major impact to it and a shift of several months is foreseen.

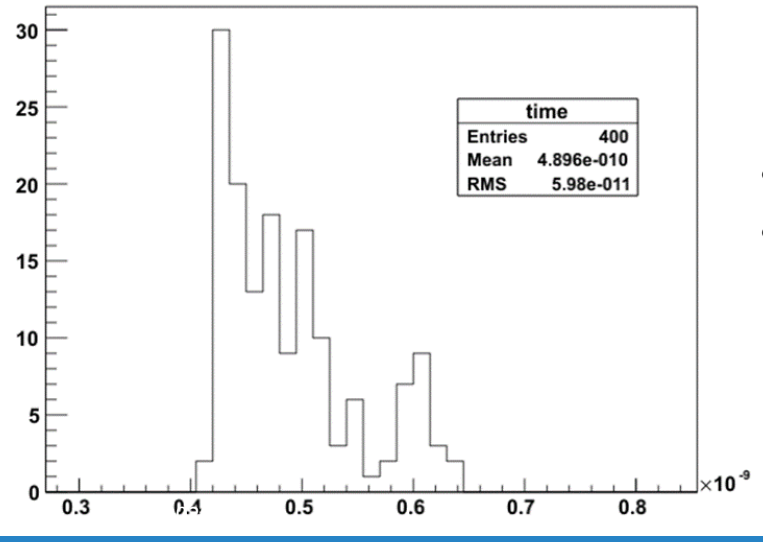
Simulations and design

Electric potential



Time of arrival





150 V @ 300K for such a cell

- Intrinsic ime resolution of around 50-60 ps for close to perpendicular tracks
- Improves with track inclination

Direction

By the time sensor arrive and real work starts:

- simulation (KDetSim and TCAD)
- we will produce 4Ch UCSC boards and distribute them
- get ALTIROC readout ready
- continue work on existing prototypes – if someone needs single channel timing boards, they are available
- develop TCT tools for looking at time resolution
  - with LGADs the main contribution to time resolution “Landau” can’t be studied by lasers
  - with 3D the main contribution E*Ew can be studied by lasers (with limitations)

Organization

I am glad we will have some PhD students working on it (Alissa, Leena, Dario and Oscar)

I would propose in initial phase a meeting like that every 2 months, later when sensors arrive every month

If anything is needed regarding the hardware, please let me know